

**CLAIMS:**

What is claimed is:

- 1 1. A method comprising:  
2 attaching a first physical extent list to a node  
3 within a tree data structure, wherein the first physical  
4 extent list contains at least one entry, the at least one  
5 entry contains a first logical address range and a  
6 starting physical address, the node has a first key, and  
7 the first key is a second logical address range, whereby  
8 a mapping relation that maps logical addresses into  
9 physical addresses on at least one storage device is  
10 achieved.
- 1 2. The method of claim 1, wherein the first logical  
2 address range includes a starting logical address and a  
3 length.
- 1 3. The method of claim 1, wherein the second logical  
2 address range corresponds to a portion of a physical copy  
3 of a storage volume.
- 1 4. The method of claim 3, wherein the physical copy of  
2 the storage volume is a mirror-in-the-middle (MIM).
- 1 5. The method of claim 1, wherein the second logical  
2 address range corresponds to an extent recorded in a  
3 journal.

Docket No. 2001-055-SFT

1 6. The method of claim 1, wherein the first physical  
2 extent list has a plurality of entries and the at least  
3 one entry is one of the plurality of entries.

1 7. The method of claim 6, wherein the plurality of  
2 entries in the first physical extent list is sorted.

1 8. The method of claim 6, wherein the plurality of  
2 entries together represent a contiguous range of logical  
3 addresses.

1 9. The method of claim 6, wherein each of the plurality  
2 of entries has an associated pointer and one of the  
3 associated pointers points to another node.

1 10. The method of claim 1, wherein the starting physical  
2 address corresponds to a physical address of an entry in  
3 a journal.

1 11. The method of claim 10, wherein the journal is one  
2 of a backward journal and a forward journal.

1 12. The method of claim 1, wherein attaching the  
2 physical extent list includes incorporating the physical  
3 extent list within the node.

1 13. The method of claim 1, wherein attaching the  
2 physical extent list includes setting a pointer within  
3 the node to point to the physical extent list.

Docket No. 2001-055-SFT

1 14. A computer program product in a computer readable  
2 medium comprising functional descriptive material that  
3 when executed by a computer enables the computer to  
4 perform acts including:

5 attaching a first physical extent list to a node  
6 within a tree data structure, wherein the first physical  
7 extent list contains at least one entry, the at least one  
8 entry contains a first logical address range and a  
9 starting physical address, the node has a first key, and  
10 the first key is a second logical address range, whereby  
11 a mapping relation that maps logical addresses into  
12 physical addresses on at least one storage device is  
13 achieved.

1 15. The computer program product of claim 14, wherein  
2 the first logical address range includes a starting  
3 logical address and a length.

1 16. The computer program product of claim 14, wherein  
2 the second logical address range corresponds to a portion  
3 of a physical copy of a storage volume.

1 17. The computer program product of claim 16, wherein  
2 the physical copy of the storage volume is a mirror-in-  
3 the-middle (MIM).

1 18. The computer program product of claim 14, wherein  
2 the second logical address range corresponds to an extent  
3 recorded in a journal.

Docket No. 2001-055-SFT

1 19. The computer program product of claim 14, wherein  
2 the first physical extent list has a plurality of entries  
3 and the at least one entry is one of the plurality of  
4 entries.

1 20. The computer program product of claim 19, wherein  
2 the plurality of entries in the first physical extent  
3 list is sorted.

1 21. The computer program product of claim 19, wherein  
2 the plurality of entries together represent a contiguous  
3 range of logical addresses.

1 22. The computer program product of claim 19, wherein  
2 each of the plurality of entries has an associated  
3 pointer and one of the associated pointers points to  
4 another node.

1 23. The computer program product of claim 14, wherein  
2 the starting physical address corresponds to a physical  
3 address of an entry in a journal.

1 24. The computer program product of claim 23, wherein  
2 the journal is one of a backward journal and a forward  
3 journal.

1 25. The computer program product of claim 14, wherein  
2 attaching the physical extent list includes incorporating  
3 the physical extent list within the node.

2001-055-SFT

Docket No. 2001-055-SFT

1 26. The computer program product of claim 14, wherein  
2 attaching the physical extent list includes setting a  
3 pointer within the node to point to the physical extent  
4 list.

1 27. A data management appliance comprising:  
2 means for attaching a first physical extent list to  
3 a node within a tree data structure, wherein the first  
4 physical extent list contains at least one entry, the at  
5 least one entry contains a first logical address range  
6 and a starting physical address, the node has a first  
7 key, and the first key is a second logical address range,  
8 whereby a mapping relation that maps logical addresses  
9 into physical addresses on at least one storage device is  
10 achieved.

1 28. The data management appliance of claim 27, wherein  
2 the first logical address range includes a starting  
3 logical address and a length.

1 29. The data management appliance of claim 27, wherein  
2 the second logical address range corresponds to a portion  
3 of a physical copy of a storage volume.

1 30. The data management appliance of claim 29, wherein  
2 the physical copy of the storage volume is a mirror-in-  
3 the-middle (MIM).

Docket No. 2001-055-SFT

1 31. The data management appliance of claim 27, wherein  
2 the second logical address range corresponds to an extent  
3 recorded in a journal.

1 32. The data management appliance of claim 27, wherein  
2 the first physical extent list has a plurality of entries  
3 and the at least one entry is one of the plurality of  
4 entries.

1 33. The data management appliance of claim 32, wherein  
2 the plurality of entries in the first physical extent  
3 list is sorted.

1 34. The data management appliance of claim 32, wherein  
2 the plurality of entries together represent a contiguous  
3 range of logical addresses.

1 35. The data management appliance of claim 32, wherein  
2 each of the plurality of entries has an associated  
3 pointer and one of the associated pointers points to  
4 another node.

1 36. The data management appliance of claim 27, wherein  
2 the starting physical address corresponds to a physical  
3 address of an entry in a journal.

1 37. The data management appliance of claim 36, wherein  
2 the journal is one of a backward journal and a forward  
3 journal.

Docket No. 2001-055-SFT

1 38. The data management appliance of claim 27, wherein  
2 attaching the physical extent list includes incorporating  
3 the physical extent list within the node.

1 39. The data management appliance of claim 27, wherein  
2 attaching the physical extent list includes setting a  
3 pointer within the node to point to the physical extent  
4 list.

1 40. A computer readable medium encoded with a data  
2 structure, the data structure comprising:  
3 a plurality of nodes; and  
4 at least one physical extent list,  
5 wherein each of the plurality of nodes contains a  
6 plurality of pointers,  
7 wherein each of the plurality of pointers points to  
8 one of a node and a physical extent list,  
9 wherein each of the nodes represents a range of  
10 logical addresses, and  
11 wherein the at least one physical extent list  
12 contains entries and the entries represent addresses of  
13 physical extents stored on at least one storage device,  
14 whereby the data structure stores a mapping relation that  
15 maps logical addresses into physical addresses on at  
16 least one storage device.

1 41. The computer readable medium of claim 40, wherein  
2 the range of logical addresses is divided into subranges  
3 and each of the plurality of pointers is associated with  
4 one of the subranges.

Docket No. 2001-055-SFT

1 42. The computer readable medium of claim 40, wherein  
2 the range of logical addresses represents data that is  
3 stored on a physical copy of a storage device.

1 43. The computer readable medium of claim 42, wherein  
2 the physical copy is a mirror-in-the-middle (MIM).

1 44. The computer readable medium of claim 40, wherein  
2 the range of logical addresses represents data that is  
3 stored within a journal.

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